

Solubility constant, K_s

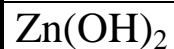
- QUESTION:** i) Write the equation for the equilibrium present in a saturated solution of the following substances
ii) write the expression for K_s for each of the following
iii) Calculate the solubility (or concentration) of the following substances in a saturated solution, in mol L^{-1}



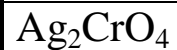
$$K_s(\text{FeS}) = 4.90 \times 10^{-18}$$



$$K_s = 4.10 \times 10^{-15}$$



$$K_s = 3.00 \times 10^{-17}$$



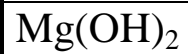
$$K_s(\text{Ag}_2\text{CrO}_4) = 3.00 \times 10^{-12}$$



$$K_s(\text{AgCl}) = 1.56 \times 10^{-10}$$



$$K_s(\text{PbCl}_2) = 1.60 \times 10^{-5}$$



$$K_s(\text{Mg(OH)}_2) = 1.25 \times 10^{-11}$$



$$K_s(\text{CaSO}_4) = 2.45 \times 10^{-5}$$



$$K_s = 3.7 \times 10^{-8}$$

Additional questions

1) Some sulfides have very low solubility products. When hydrogen sulfide gas is bubbled through solutions of these ions, these ions separate from a mixture of ions. In a saturated solution of hydrogen sulfide $[\text{H}_3\text{O}^+]^2[\text{S}^{2-}] = 1.10 \times 10^{-23}$ Calculate the sulfide ion concentration when the pH of the solution is 4.20.

2) Solid sodium chloride is added to 5.00 L of 0.100 mol L⁻¹ silver nitrate solution.

Calculate the minimum mass of sodium chloride that would be needed to produce a saturated solution of AgCl. Assume that there is no change in volume when the sodium chloride is added. $M(\text{NaCl}) = 58.5 \text{ g mol}^{-1}$

3) a) Describe what is meant by the term ‘solubility’.

b) The solubility product, K_s , of AgCl has a value of 1.56×10^{-10} at 25°C and this value increases to 2.15×10^{-8} at 100°C. Explain why K_s is higher at 100°C. Include reference to the relevant equilibrium equation in your answer.

c) The chloride ion concentration in sea water can be determined by titrating a sample with aqueous silver nitrate (AgNO_3) using potassium chromate (K_2CrO_4) as the indicator.

As the silver nitrate is added, a precipitate of silver chloride, (AgCl) forms. When most of the AgCl has precipitated, the $\text{Ag}^+(\text{aq})$ concentration becomes high enough for a red precipitate of Ag_2CrO_4 to form.

Show that the solubility of Ag_2CrO_4 in pure water at 25 °C is higher than that of AgCl . $K_s(\text{AgCl}) = 1.56 \times 10^{-10}$ $K_s(\text{Ag}_2\text{CrO}_4) = 1.30 \times 10^{-12}$

d) If the concentration of chromate ions is $6.30 \times 10^{-3} \text{ mol L}^{-1}$ at the point when the Ag_2CrO_4 starts to precipitate, calculate the concentration of Ag^+ ions in the solution.